

\* NOTICES \*

JP Pub No. 2001-029518

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

## DETAILED DESCRIPTION

---

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the charge of the golf club head material made from a titanium alloy.

[0002]

[Description of the Prior Art] Many golf club heads made from titanium or a titanium alloy have come to be used. As for a titanium alloy, compared with stainless steel, it is possible for the flexibility of a design to, create a much more big head compared with increase and the head made from stainless steel light moreover, since intensity is high. The hit ball which the sweet spot spread and was stabilized by the much more big head comes to be obtained.

[0003] As a titanium alloy used as a charge of golf club head material, beta titanium alloys, such as alpha plus beta titanium alloys, such as Ti-6aluminum-4V alloy (hereafter referred to as "64AT".) and a Ti-4.5aluminum-3V-2Fe-2Mo alloy, and a Ti-15V-3Cr-3Sn-3aluminum alloy, are mentioned.

[0004] 64ATs are titanium alloys currently that in various fields used, and its actual result as a charge of aircraft material is especially high. [ most ] However, since cold working of 64AT is impossible, it needs cost that it is difficult to manufacture the 1-5mm plate generally demanded as a charge of golf club head material, and great. Therefore, the golf club head made from 64ATs is produced by casting as indicated by JP,3-230845,A, for example. However, further, since titanium tends to oxidize, it cannot be cast in the atmosphere, but titanium needs very advanced technology in order to tend to react with mold, and it serves as cost quantity as a result. Moreover, since a casting cannot control a metal texture easily compared with a rolled stock, it has the fault that it is weak in intensity.

[0005] On the other hand, since a Ti-4.5aluminum-3V-2Fe-2Mo alloy can do superplasticity forming, it can obtain the product of high intensity comparatively easily. However, special equipment is needed for superplasticity forming, and much time is needed for carrying out superplasticity forming further, and it is not fit for mass production method.

[0006] On the other hand, many beta titanium alloys with good cold-working nature, such as a Ti-15Mo-5Zr-3aluminum alloy and a Ti-15V-3Cr-3Sn-3aluminum alloy, came to be used in recent years.

Drawing 3 is drawing showing the conventional manufacturing process of the golf club head made from a beta titanium alloy. Usually, the hot rolling going-up material of the beta titanium alloy manufactured according to the process is cold-rolled, and the plate of predetermined thickness is obtained. this plate -- after solution treatment and between the cold -- or press working of sheet metal between \*\* is carried out, and the member of a desired configuration is produced And a member is joined by welding and it assembles in the configuration of a golf club head. After that, solution treatment is performed, then an aging treatment is performed.

[0007]

[Problem(s) to be Solved by the Invention] However, although the thinning of the face of a golf club head had been attained in order to fly a ball to a distance more, the problem that a crack occurred by the shock at the time of a hit ball arose in recent years.

## BEST AVAILABLE COPY

[0008] Drawing 2 is the schematic diagram of a golf club head. In the face front face 101 of the golf club head 1, the semicircle slot-like score-line 102 is intermittent in the shape of a straight line, and it is arranged mutually at the straight-line up or parallel. Drawing 4 is an A-A' cross section in drawing 2. As a result of investigating the crack concerned in detail, the crack occurred from the pars basilaris ossis occipitalis of the score line 102, it spread in the whole beta-titanium-alloy plate 105, and the crack 2 and the bird clapper were found out. 103 shows a face rear face. Furthermore, having generated made many cracks clear from the score line pars basilaris ossis occipitalis for a center section of a face. The following thing was understood when material strength analysis of a golf club head was performed. Load about 1t or more joins a face at the time of a hit ball, and a face should curve inside a golf club head. Carry out stress concentration especially of the stress generated at the time of the curve of a face to a score line pars basilaris ossis occipitalis. Therefore, with a score line pars basilaris ossis occipitalis as the starting point, a crack should occur and spread.

[0009] Moreover, in the conventional manufacturing process of the golf club head made from a beta titanium alloy, there is a problem that the time of an aging treatment is very long required, and a manufacturing cost becomes high.

[0010] this invention is wholeheartedly examined in view of the starting trouble, and is the purpose's being excellent in endurance with high intensity, and developing the charge of the golf club head material made from a titanium alloy with a comparatively cheap manufacturing cost.

[0011]

[Means for Solving the Problem] The above-mentioned purpose found out that it could assemble on a golf club head with cold rolling of the charge of the golf club head material made from a titanium alloy concerning this invention given in claims 1-3, i.e., a beta titanium alloy, and a crack could be prevented only by the aging treatment.

[0012] In the desirable embodiment of this invention, the degree of cold working is 15% or more like the publication to a claim 3.

[0013]

[Embodiments of the Invention] Hereafter, the operation gestalt of this invention is explained in detail.

[0014] Drawing 1 is drawing showing the manufacturing process of the golf club head made from a titanium alloy concerning this invention. necessary -- the beta-titanium-alloy ingot was manufactured for the alloy raw material of a mixing ratio by the formula [ exhausting ] electrode arc dissolution As other ingot manufacture methods, although the non-exhausting formula electrode arc dissolution, electron beam melting, plasma arc melting, and the electro dissolution are mentioned, a beta-titanium-alloy ingot can be manufactured by any manufacture method. Next, hot-rolling an ingot at the hot rolling temperature of 900-950 degrees C, solution treatment is performed simultaneously and hot rolling material is manufactured. It is necessary to control hot rolling and solution treatment so that any phases other than beta phase do not deposit in hot rolling material. That is, it is important to control hot rolling temperature especially so that hot rolling material may serve as beta single phase. Then, hot rolling material is cold-rolled and the cold rolling material of 2.7mm of board thickness is manufactured. It is desirable to make the rate of cold rolling into 15% or more. cold rolling material -- between the colds -- or -- or press working of sheet metal is carried out, and the member of a predetermined configuration is produced, a member is joined by welding, and it considers as the configuration of a golf club head After that, in this invention, solution treatment is not performed, but directly, at the aging temperature (preferably 450 degrees C) of 300-500 degrees C, is held for about 8 hours and carries out an aging treatment. In the aging treatment of this operation gestalt, although it is possible to advance an aging deposit early more, with work hardening by cold rolling maintained, if the rate of cold rolling (the degree of cold working) is made into 15% or more, it will become still more remarkable. On the other hand, if it heats at 600 degrees C or more, since aging does not progress, but distortion is removed, it softens and it recrystallizes further, it is not desirable.

[0015] In manufacture of the golf club head of this invention, it is necessary to fully suppress hydrogen absorption. Especially, in the pickling process, you should fully pay attention at pickling liquid, pickling temperature, pickling time, etc. In the conventional method, although solution treatment is placed near

the final process and the dehydrogenation was able to be performed with solution treatment, in this invention, it is because solution treatment is placed before farther than a final process.

[0016]

[Example] About the hot rolling material of a Ti-15V-3Cr-3Sn-3aluminum alloy, various processing conditions after hot rolling were changed, the sample was manufactured, and the property of hardness and proof stress was compared. Table 1 is a table which compared the property of the hardness in the various samples of a Ti-15V-3Cr-3Sn-3aluminum alloy, and proof stress.

[Table 1]

表1 各種試料について時効処理(450℃ X 8時間)後の硬さと耐力の測定結果

試料	加工条件	硬さ:HV1.0	耐力(N/mm <sup>2</sup> )
実施例1	溶体化+10%冷間加工	357	1038
実施例2	溶体化+15%冷間加工	393	1179
実施例3	溶体化+30%冷間加工	415	1244
実施例4	溶体化+50%冷間加工	450	1387
実施例5	熱間上がり+直接30%冷間加工	427	1262
比較例1	溶体化上がり材	341	997

[0017] Although examples 1-4 are common at the point which is carrying out solution treatment at 900-950 degrees C after hot rolling, they differ after that in [ the 10% of the degrees of cold working, 15%, 30%, and 50% of ] that it is cold-working, respectively. Hardness increases to 450 from 357, and proof stress is increasing 1038Ns /to 2 mm as the degree of cold working increases. Moreover, an example 5 performs cold working of the 30% of the degrees of direct cold working after hot rolling, and solution treatment is not performed. The hardness of an example 5 is 427, and 1262Ns /of proof stress are [ mm ] 2, and it compares with examples 1-4, and is a low slightly. In addition, as for examples 1-5, the aging treatment of 450 degree-Cx 8 hours is given after cold working. On the other hand, after carrying out solution treatment of the example 1 of comparison at 850-900 degrees C after cold rolling, the aging treatment of 450 degree-Cx 8 hours is given. 997Ns /of proof stress are [ mm ] 2, hardness is 341 and it is [ all of the example 1 of comparison are lower than examples 1-5, and ] inferior in intensity.

[0018] Next, endurance was examined using the golf test-forming testing machine about the various golf club heads manufactured with the Ti-15V-3Cr-3Sn-3aluminum alloy. Table 2 is a table showing the endurance test result about the various golf club heads manufactured with the Ti-15V-3Cr-3Sn-3aluminum alloy of an example and the example of comparison.

[Table 2]

表2 各種ゴルフクラブについての試打試験結果

ゴルフクラブ	フェース材	熱処理	割れが生ずるまでの試打回数
実施例11	30%冷間圧延材	時効	5000回以上試打後も割れ無し
実施例12	50%冷間圧延材	時効	5000回以上試打後も割れ無し
比較例11	30%冷間圧延材	溶体化+時効	3200回
比較例12	30%冷間圧延材	溶体化	1500回
比較例13	熱間上がり材	溶体化+時効	2700回
比較例14	熱間上がり材	溶体化	1000回

条件: ヘッドスピード=48m/秒  
 ヘッド容量=300cc  
 フェース板厚=2.7mm  
 クラウン板厚=1mm  
 ソール板厚=1.15mm  
 時効条件=400℃ X 8時間

[0019] After assembling examples 11 and 12 on a head, without carrying out after [ cold rolling ] solution treatment by various workability, they are the golf clubs manufactured with the Ti-15V-3Cr-3Sn-3aluminum alloy (henceforth 15-3T) which carried out aging directly for 400 degree-Cx 8 hours. When test forming was repeated in head speed 48m/a second, even if it carried out test forming 5000 times, a crack did not arise on a golf club head. The crack produced the example 11 of comparison which is the golf club head manufactured on the other hand by 15-3T which carried out solution treatment after cold rolling on the golf club head as a result of 3200 times of test forming. The crack

produced the example 13 of comparison which is the golf club head manufactured after hot rolling by solution treatment and the titanium alloy by which the aging treatment was carried out on the golf club head as a result of 2700 times of test forming. Cold working after solution treatment was not performed, but the crack arose on the golf club head further in the examples 12 and 14 of comparison which are not performing the aging treatment as a result of 1500 times and 1000 times of test forming, respectively. It was proved that a crack cannot produce the golf club head of this example easily due to repeat test forming, and a life is prolonged sharply.

[0020]

[Effect of the Invention] Since the charge of golf club head material of this invention does not carry out solution treatment of the beta-titanium-alloy plate cold-rolled and obtained press working of sheet metal between \*\*, after carrying out welding processing and considering as the configuration of a golf club head, and after [ between the colds or ], but it carries out only an aging treatment and is manufactured While depositing alpha phase in beta Aiuchi by the aging treatment and raising intensity, in order not to perform solution treatment after cold working, work hardening by cold working (between the colds or or cold rolling and press working of sheet metal) is not removed, but the charge of golf club head material excellent in proof stress and hardness is obtained.

Adv. [0021] The charge of golf club head material of this invention is considered to be the result which obtained sufficient proof stress and sufficient hardness, preventing the brittleness by overaging, when the improvement in on the strength by work hardening also applies the intensity conventionally obtained only by aging, and even if it carries out a repeat hit ball, the effect of being hard to produce a crack on a golf club head is acquired.

[0022] Furthermore, the charge of golf club head material of this invention Since solution treatment of the beta-titanium-alloy plate cold-rolled and obtained is not carried out press working of sheet metal between \*\*, after carrying out welding processing and considering as the configuration of a golf club head, and after [ between the colds or ], but only an aging treatment is carried out and it is manufactured Since it remains without releasing the processing distortion in a beta titanium alloy, and residual stress, improvement in the proof stress by work hardening and hardness can be desired above, the deposit of alpha phase at the time of an aging treatment is promoted, and required aging time is shortened. The effect that a manufacturing cost is mitigated is acquired as the result.

---

[Translation done.]